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(54) **SPEECH LEARNING APPARATUS AND METHOD**

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G09B 5/06 (2006.01)

(52) **U.S. Cl.**
CPC ***G09B 19/04*** (2013.01); ***G09B 5/06*** (2013.01)

(58) **Field of Classification Search**
CPC G09B 19/04
USPC 434/185
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,397,183	B1	5/2002	Baba et al.	
2009/0299733	A1	12/2009	Agapi et al.	
2013/0085955	A1*	4/2013	Dugas	705/326

FOREIGN PATENT DOCUMENTS

JP	4-66998	H	3/1992
JP	6-266382	A	9/1994
JP	H10-274999	A	10/1998
JP	H11-327870	A	11/1999
JP	2004-246085	A	9/2004
WO	2000021057	A1	4/2000

OTHER PUBLICATIONS

Japanese First Office Action dated Jun. 24, 2014 from corresponding Japanese Patent Application No. 2012-180447, 4 pages.

* cited by examiner

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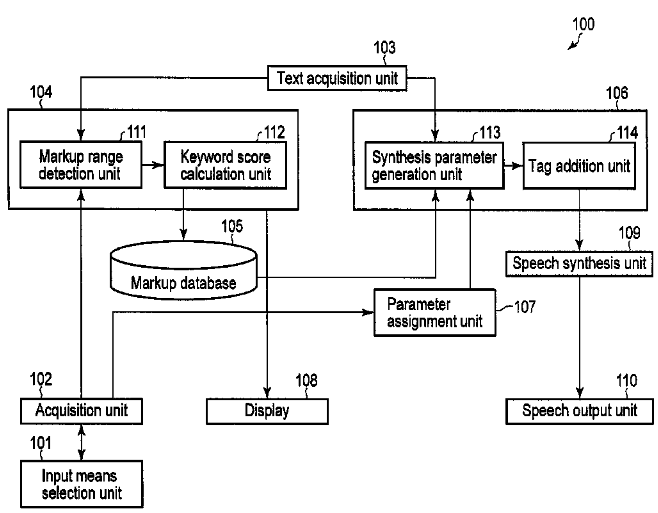
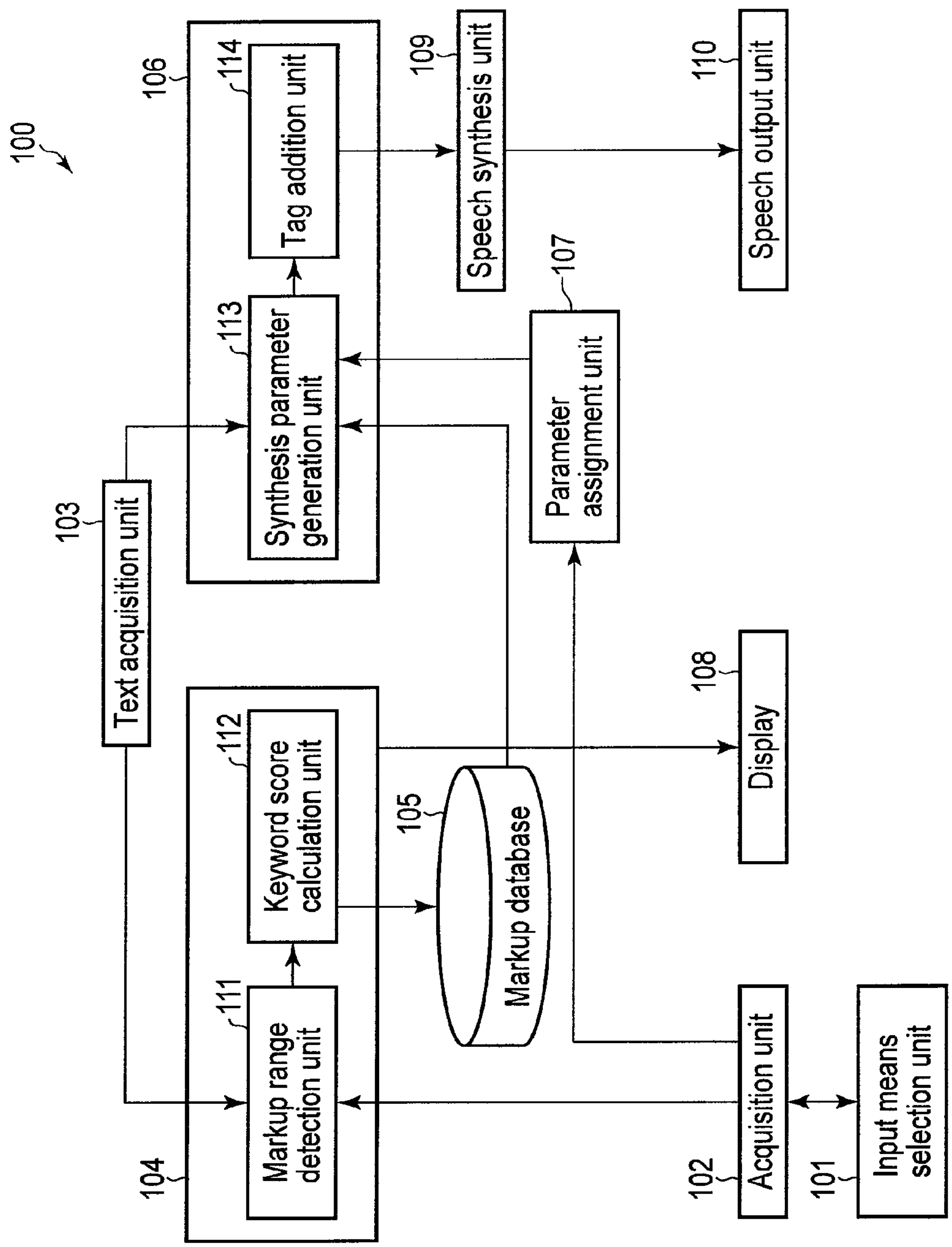
(74) *Attorney, Agent, or Firm* — Ohlandt, Greeley, Ruggiero & Perle, L.L.P.

(57) **ABSTRACT**

According to one embodiment, a speech learning apparatus includes a detection unit, a first calculation unit, a generation unit, an addition unit and a speech synthesis unit. The first calculation unit calculates a score indicating a degree of emphasis of a keyword based on a type of the marker and a manner of selecting the keyword. The generation unit generates a synthesis parameter to determine a degree of reading of the keyword in accordance with the score and the type of the marker. The addition unit adds to the keyword a tag for reading the keyword in accordance with the synthesis parameter. The speech synthesis unit generates synthesized speech obtained by synthesizing speech of the keyword in accordance with the tag.

7 Claims, 11 Drawing Sheets




100
106
114
Tag addition unit
109
Speech synthesis unit
110
Speech output unit
113
Synthesis parameter generation unit
107
Parameter assignment unit
103
Text acquisition unit
104
111
Markup range detection unit
112
Keyword score calculation unit
105
Markup database
108
Display
102
Acquisition unit
101
Input means selection unit

F I G. 1

201 202 203 204 205

206

Content ID	Location	Keyword	Marker type	Score
12345	0-17	19th-century Italy	Underline	0.3
12345	40-54	Pope' s territory	Yellow marker	0.5
12345	62-88	Kingdom of the Two Sicilies	Yellow marker + underline	0.8
12345	95-113	Kingdom of Sardinia	Yellow marker	0.5
12345	141-148	Carbonari	Red marker	1.0
...	...	...	...	...

FIG. 2

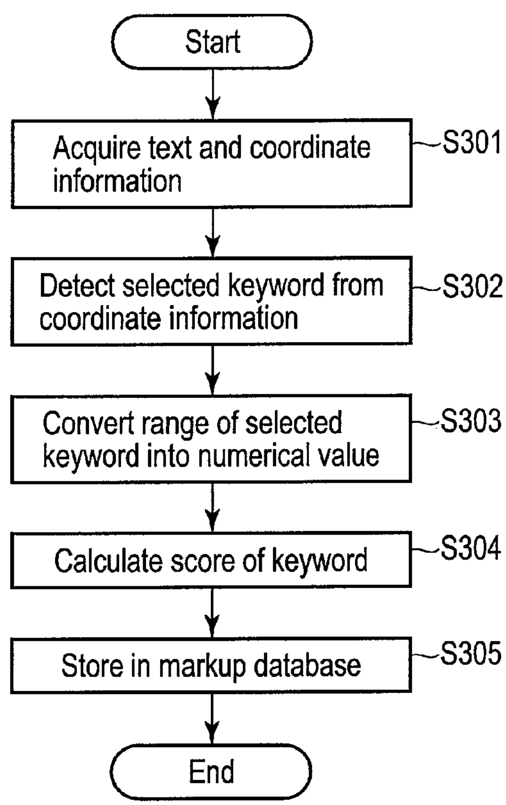
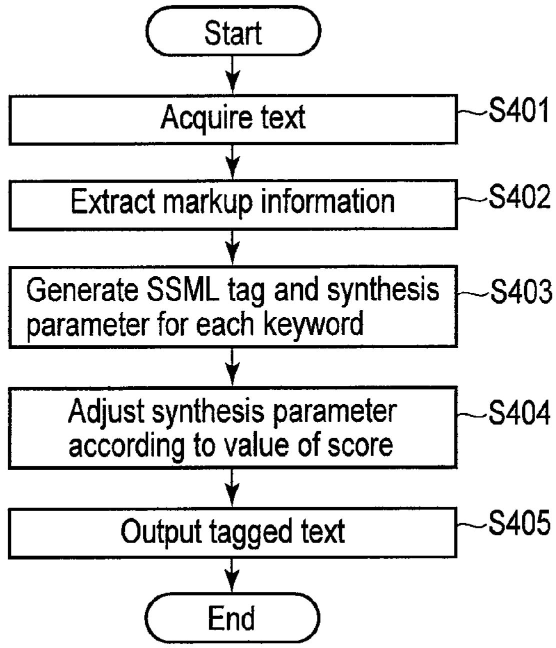


FIG. 3



F I G. 4

501 502 503

Marker type	Reading	Synthesis parameter
Yellow marker	<prosody pitch>	+30%
Red marker	<prosody volume> <prosody rate>	+100 -50%
Underline	<emphasis>	strong
Wavy line	<voice>	Alice

F I G. 5

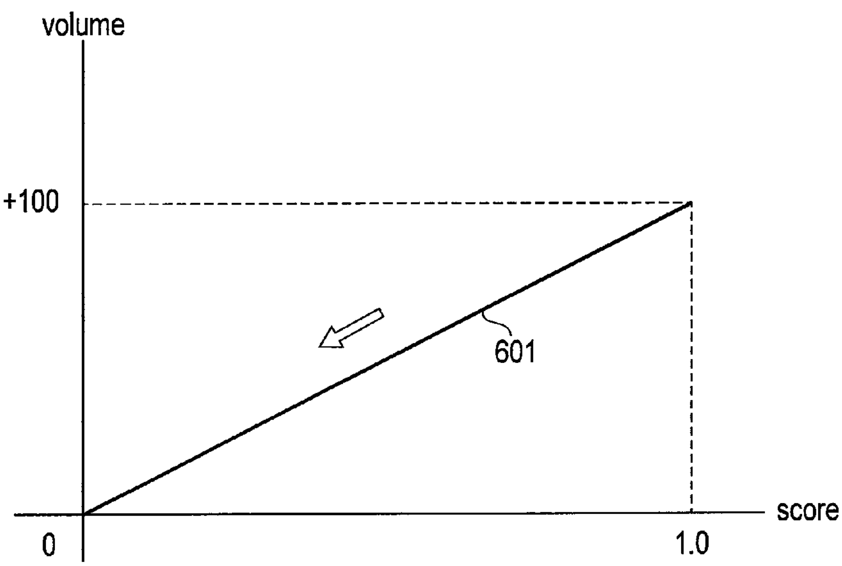


FIG. 6

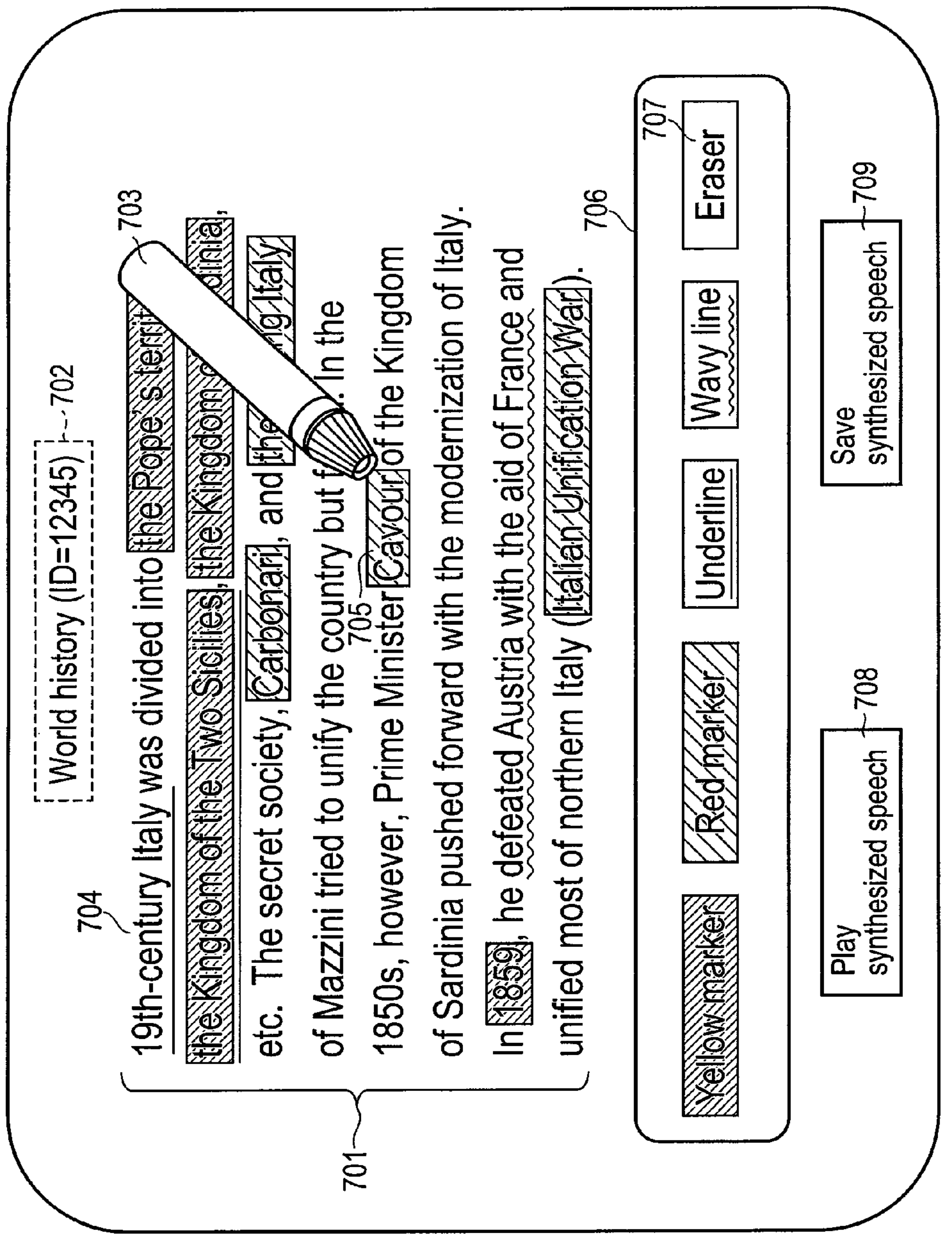
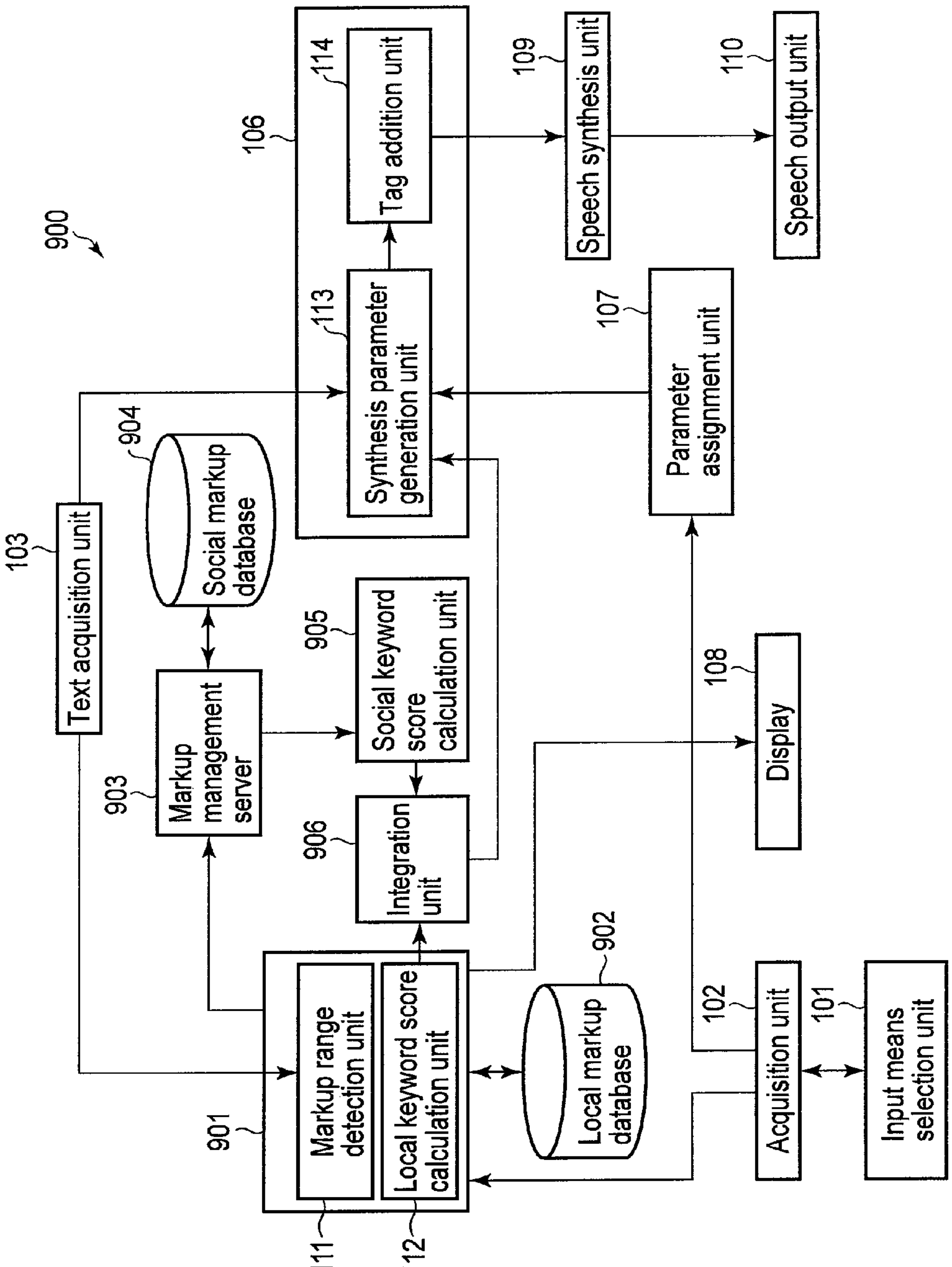

World history (ID=12345)
702
704
703
19th-century Italy was divided into the Pope's terri
the Kingdom of the Two Sicilies, the Kingdom
dinia,
etc. The secret society, Carbonari, and the
g Italy
of Mazzini tried to unify the country but f
. In the
705
1850s, however, Prime Minister Cavour of the Kingdom
of Sardinia pushed forward with the modernization of Italy.
In 1859, he defeated Austria with the aid of France and
unified most of northern Italy (Italian Unification War).
701
706
707
Yellow marker
Red marker
Underline
Wavy line
Eraser
708
Play synthesized speech
709
Save synthesized speech

FIG. 7

801 802

<emphasis level="strong">19th-century Italy</emphasis> was divided into <prosody pitch="+30%">the Pope' s territory</prosody>, <prosody pitch="+30%">the Kingdom of the Two Sicilies</prosody>, <prosody pitch="+30%">the Kingdom of Sardinia </prosody>, etc. The secret society<prosody volume="+100" rate="−50%">,Carbonari, </prosody> and the Young Italy</prosody> of Mazzini<prosody volume="+100" rate= "−50%"> tried to unify the country but failed. In the 1850s, however, Prime Minister <prosody volume="+100" rate="−50%">Cavour</prosody> of the Kingdom of Sardinia pushed forward with the modernization of Italy. In <prosody pitch="+30%">1859 </prosody>, he <voice variant="alice">defeated Austria with the aid of France</voice> and unified most of northern Italy (<prosody volume="+100" rate="−50%">Italian Unification War</prosody>).

FIG. 8


900
106
114
Tag addition unit
113
Synthesis parameter generation unit
109
Speech synthesis unit
110
Speech output unit
107
Parameter assignment unit
103
Text acquisition unit
904
Social markup database
903
Markup management server
905
Social keyword score calculation unit
906
Integration unit
108
Display
901
Markup range detection unit
Local keyword score calculation unit
111
112
902
Local markup database
102
Acquisition unit
101
Input means selection unit

F I G. 9

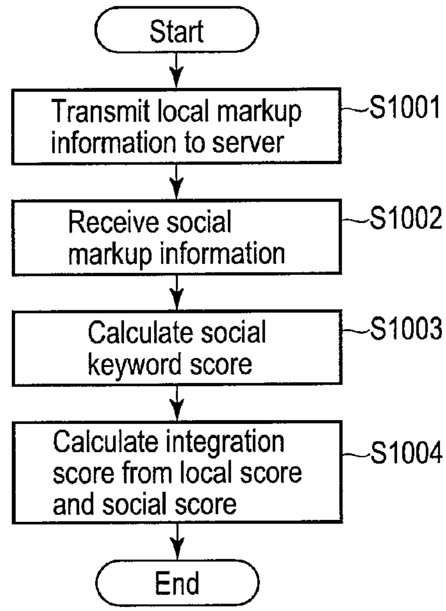
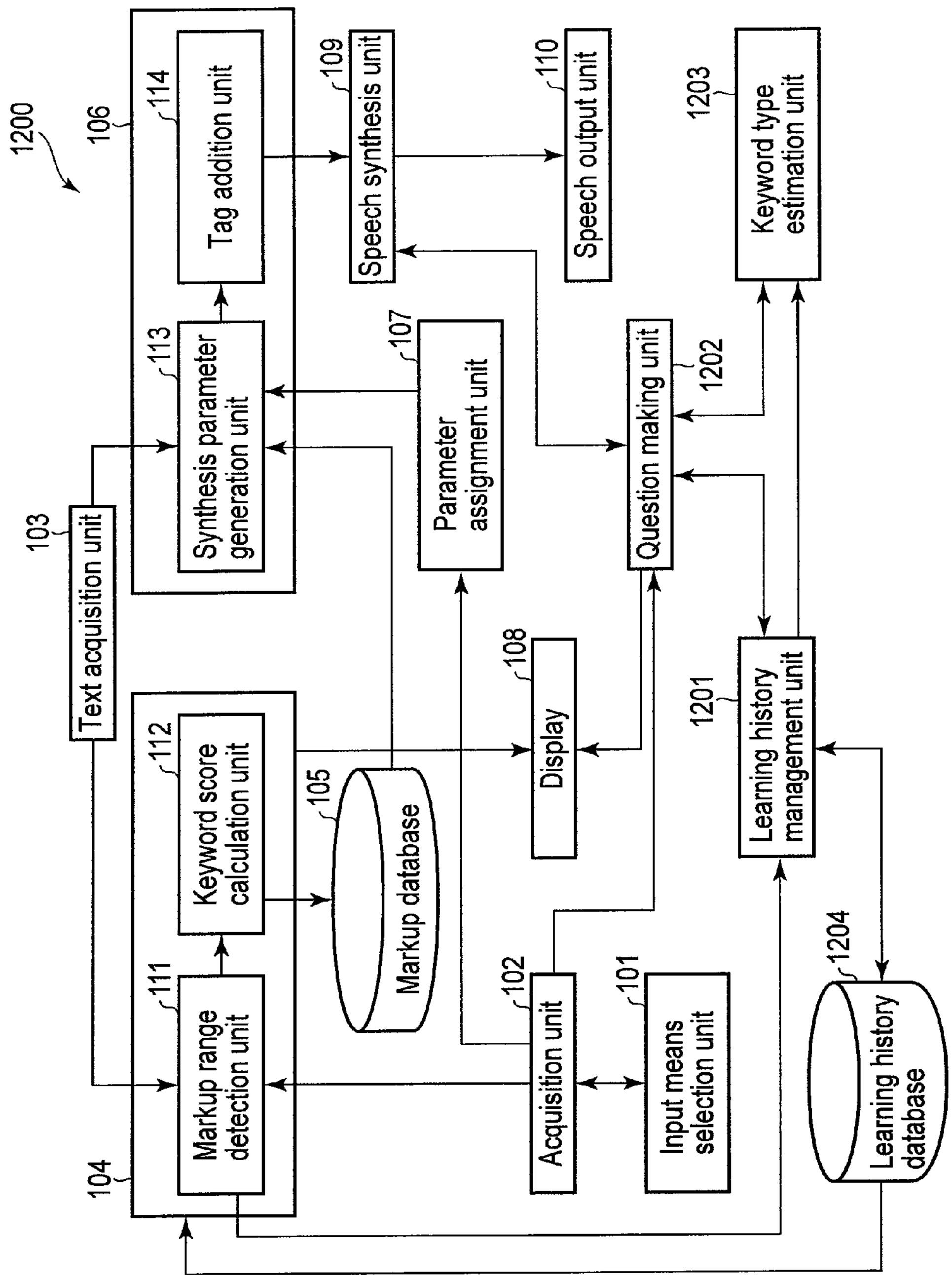


FIG. 10

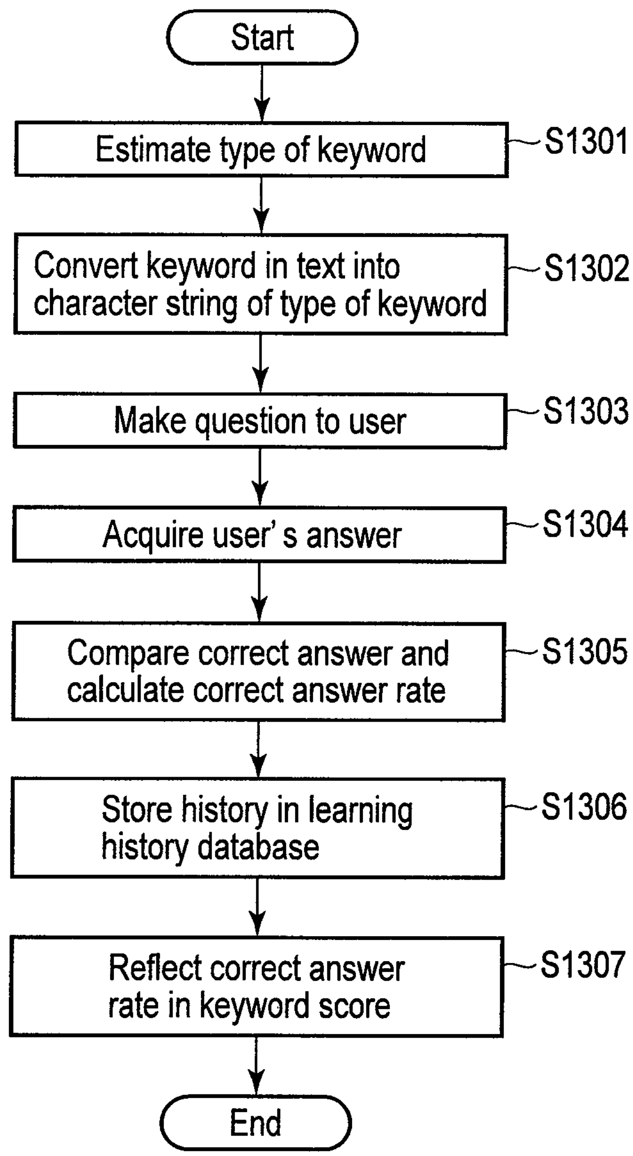
Content ID (201)	User ID (1102)	Location (202)	Keyword (203)	Marker type (204)	Score (205)
12345	100	40-54	Pope' s territory	Yellow marker	1.0
12345	100	62-88	Kingdom of the Two Sicilies	Yellow marker	0.8
12345	100	95-113	Kingdom of Sardinia	Yellow marker	0.8
12345	200	95-113	Kingdom of Sardinia	Red marker	1.0
12345	300	95-113	Kingdom of Sardinia	Yellow marker	0.8
12345	100	141-148	Carbonari	Red marker	1.0
...		...	...	...	...

1101

FIG. 11


1200
106
114
Tag addition unit
109
Speech synthesis unit
110
Speech output unit
1203
Keyword type estimation unit
103
Text acquisition unit
113
Synthesis parameter generation unit
107
Parameter assignment unit
1202
Question making unit
104
111
Markup range detection unit
112
Keyword score calculation unit
105
Markup database
108
Display
1201
Learning history management unit
102
Acquisition unit
101
Input means selection unit
1204
Learning history database

F I G. 1 2


Start
Estimate type of keyword
S1301
Convert keyword in text into character string of type of keyword
S1302
Make question to user
S1303
Acquire user' s answer
S1304
Compare correct answer and calculate correct answer rate
S1305
Store history in learning history database
S1306
Reflect correct answer rate in keyword score
S1307
End

F I G. 1 3

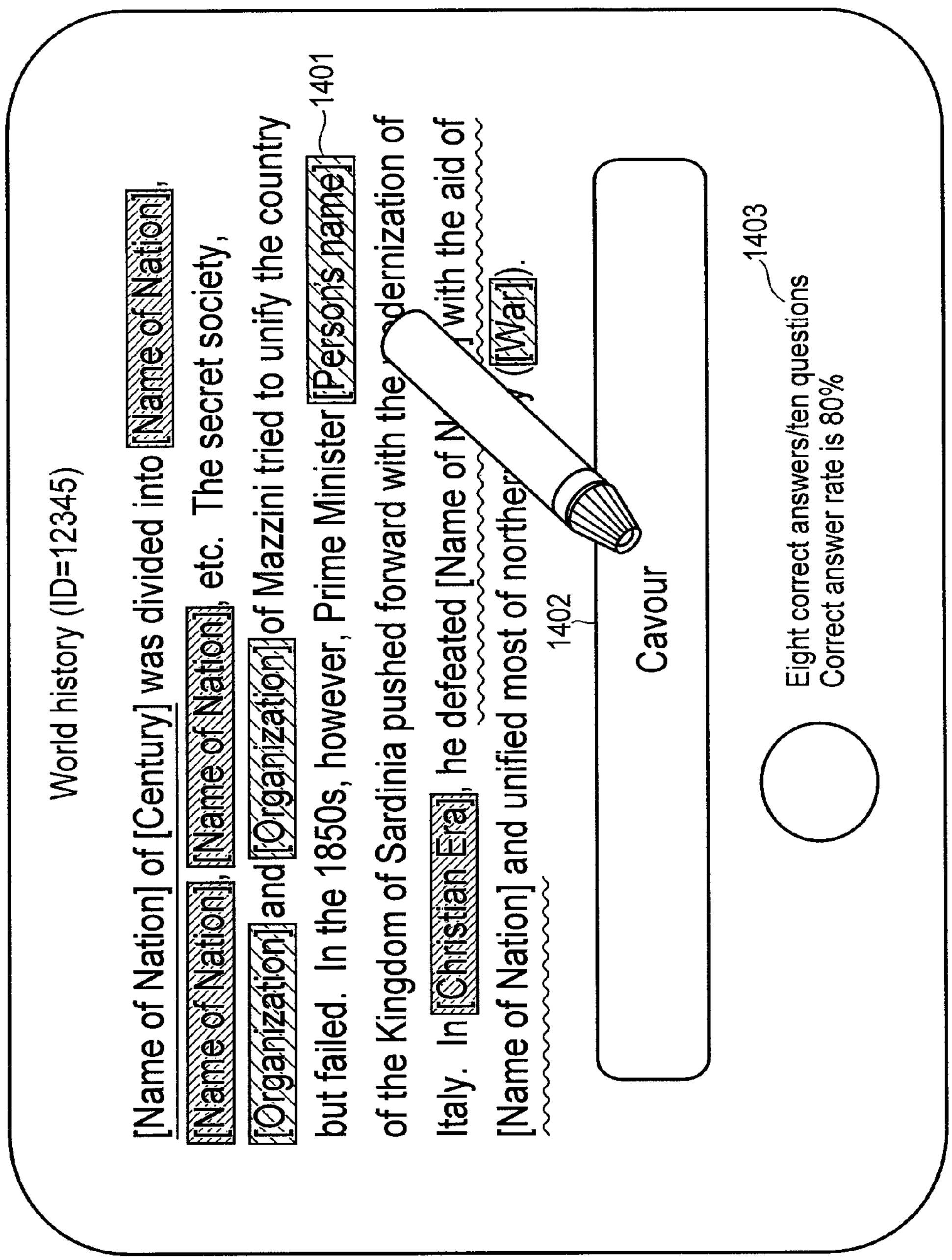

World history (ID=12345)
[Name of Nation] of [Century] was divided into [Name of Nation],
[Name of Nation], [Name of Nation], etc. The secret society,
[Organization] and [Organization] of Mazzini tried to unify the country
but failed. In the 1850s, however, Prime Minister [Person's name]
1401
of the Kingdom of Sardinia pushed forward with the
dernization of
Italy. In [Christian Era], he defeated [Name of N
with the aid of
[Name of Nation] and unified most of norther
([War]).
1402
Cavour
1403
Eight correct answers/ten questions
Correct answer rate is 80%

FIG. 14

SPEECH LEARNING APPARATUS AND METHOD

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is based upon and claims the benefit of priority from Japanese Patent Application No. 2012-180447, filed Aug. 16, 2012, the entire contents of which are incorporated herein by reference.

FIELD

Embodiments described herein relate generally to a speech learning apparatus and method.

BACKGROUND

As electronic books and electronic textbooks become popular, learners have been able to employ a new learning method in which they understand the content of the electronic books and textbooks not only by eyes but also by ears using a speech synthesis technology. There is a great advantage to understanding the content of electronic books and electronic textbooks by ears. For example, a learning method for memorizing text while listing to the text repeatedly is called speech learning and it is known that the learning method improves learning efficiency. In this method, however, reading of synthesized speech is monotonous and thus it is hard to understand what is important. To prevent this, there is a technique of generating well-modulated synthesized speech using markup language called speech synthesis markup language (SSML).

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram illustrating a speech learning apparatus according to a first embodiment;

FIG. **2** is a table illustrating an example of markup information stored in a markup database;

FIG. **3** is a flowchart illustrating an operation of a markup management unit;

FIG. **4** is a flowchart illustrating an operation of a tagged text generation unit;

FIG. **5** is a table illustrating an example of a synthesis parameter generation method in a synthesis parameter generation unit;

FIG. **6** is a graph illustrating an example of a score adjustment method in the synthesis parameter generation unit;

FIG. **7** illustrates an example of use of a speech learning apparatus according to a first embodiment;

FIG. **8** illustrates an example of a tagged text generated by a tag addition unit;

FIG. **9** is a block diagram illustrating a speech learning apparatus according to a second embodiment;

FIG. **10** is a flowchart illustrating an operation of the speech learning apparatus according to the second embodiment;

FIG. **11** is a table illustrating an example of social markup information stored in a social markup database;

FIG. **12** is a block diagram illustrating a speech learning apparatus according to a third embodiment;

FIG. **13** is a flowchart illustrating an operation of the speech learning apparatus according to the third embodiment; and

FIG. **14** illustrates an example of use of the speech learning apparatus according to the third embodiment.

DETAILED DESCRIPTION

In the technique described in the above, there is no interface for designating an important keyword through interaction with a user. For all users that listen to the same content, the same keyword will be emphasized. Thus, the users are unable to easily customize the speech corresponding to the content in accordance with their own learning states.

Furthermore, the above technique does not dynamically keep up with a change in importance of keywords with user's learning progress. The keywords that a user has already memorized are still emphasized and read. It is thus difficult for the user to understand what is important for learning.

In general, according to one embodiment, a speech learning apparatus includes a detection unit, a first calculation unit, a generation unit, an addition unit and a speech synthesis unit. The detection unit is configured to detect a keyword corresponding to a character string selected from text by a user using a marker. The first calculation unit is configured to calculate a score indicating a degree of emphasis of the keyword based on a type of the marker and a manner of selecting the keyword. The generation unit is configured to generate a synthesis parameter to determine a degree of reading of the keyword in accordance with the score and the type of the marker. The addition unit is configured to add to the keyword a tag for reading the keyword in accordance with the synthesis parameter. The speech synthesis unit is configured to generate synthesized speech obtained by synthesizing speech of the keyword in accordance with the tag.

Referring to the accompanying drawings, a speech learning apparatus, method and program according to the following embodiments will be described below. In the embodiments, the respective units denoted by the same reference numeral perform the same operation and thus their overlapping descriptions will be omitted as appropriate.

First Embodiment

A speech learning apparatus according to a first embodiment will be described with reference to the block diagram shown in FIG. **1**.

FIG. **1** shows a speech learning apparatus **100** according to the first embodiment. The apparatus **100** includes an input means selection unit **101**, an acquisition unit **102**, a text acquisition unit **103**, a markup management unit **104**, a markup database **105**, a tagged text generation unit **106**, a parameter assignment unit **107**, a display **108**, a speech synthesis unit **109** and a speech output unit **110**. The markup management unit **104** includes a markup range detection unit **111** and a keyword score calculation unit **112**. The tagged text generation unit **106** includes a synthesis parameter generation unit **113** and a tag addition unit **114**.

The input means selection unit **101** selects a type of marker designated by a user. The marker is a means for designating the range of a character string and the way to read the character string through the speech synthesis.

The acquisition unit **102** receives the type of marker selected by the input means selection unit **101**. The acquisition unit **102** acquires coordinate information on the screen selected by the user.

The text acquisition unit **103** acquires the text of content such as an electronic book and an electronic textbook.

The markup management unit **104** receives the type of marker and the coordinate information from the acquisition unit **102** and also receives the text of content from the text acquisition unit **103**. The markup management unit **104** calculates a score of a keyword that is a character string designated by the user using the marker. The unit **104** also generates a text marked up by the marker (referred to as a markup text hereinafter).

The markup database **105** receives the score from the markup management unit **104** and stores it as markup information. The markup information will be described later with reference to FIG. **2**.

The tagged text generation unit **106** receives the text of content from the text acquisition unit **103**. Referring to the markup information stored in the markup database **105**, the unit **106** generates a synthesis parameter and adds a tag corresponding to the synthesis parameter to the text. The synthesis parameter is a parameter for determining a degree of reading of the text and its descriptions will be given later with reference to FIG. **5**. In the first embodiment, the tag is assumed as an SSML tag; however, any tag can be used if it can control reading of text.

The parameter assignment unit **107** changes assignment of the tag and synthesis parameter to the marker according to user's designation.

The display **108** receives the markup text from the markup management unit **104** and displays it.

The speech synthesis unit **109** receives a tagged text from the tagged text generation unit **106** to synthesize the speech of the tagged text into synthesized speech. Speech synthesis processing is commonly known and thus its explanation is omitted.

The speech output unit **110** receives the synthesized speech from the speech synthesis unit **109** and outputs it.

The markup management unit **104** will be described in detail.

The markup range detection unit **111** receives the type of marker and the coordinate information from the acquisition unit **102** and also receives the text of content from the text acquisition unit **103** to detect a character string from the designation range of the marker on the basis of the coordinate information, thereby obtaining a keyword. The unit **111** also detects a method of designating a keyword by the user using the marker and detects a markup text.

The keyword score calculation unit **112** receives the type of marker and the method of designating a keyword using the marker from the markup range detection unit **111** and calculates a score of the keyword.

The tagged text generation unit **106** will be described in detail below.

The synthesis parameter generation unit **113** receives text and markup information from the text acquisition unit **103** and the markup database **105**, respectively to generate a synthesis parameter for each keyword.

The tag addition unit **114** receives the text and the synthesis parameter of each keyword from the synthesis parameter generation unit **113** to add an SSML tag to the keyword so as to read a character string in accordance with the synthesis parameter.

An example of the markup information stored in the markup database **105** will be described with reference to FIG. **2**.

Referring to FIG. **2**, content ID **201**, location **202**, keyword **203**, marker type **204** and score **205** correspond to one another and are stored as markup information **206**.

The content ID **201** is an identifier uniquely assigned to each type of the content. The location **202** indicates a location in which a keyword appears and, in the example of FIG. **2**, it indicates the number of characters of content from the beginning. The keyword **203** indicates a marked-up character string. The marker type **204** indicates the type of a marker used for markup. The score **205** indicates a degree of emphasis of a keyword, which corresponds to the marker type.

As a specific example of the markup information **206** to be stored, “12345” of content ID **201**, “0-17” of location **202**, “19th century Italy” of keyword **203**, “underline” of marker type **204** and “0.3” of score **205** correspond to one another.

The operation of the markup management unit **104** will be described below with reference to the flowchart of FIG. **3**.

In step S**301**, the markup range detection unit **111** acquires text and coordinate information on a screen selected by a user.

In step S**302**, the markup range detection unit **111** detects which character string is selected from the coordinate information and acquires a selected keyword of the selected character string. The method of detecting a keyword selected from the coordinate information is commonly known and thus its explanation is omitted.

In step S**303**, the markup range detection unit **111** converts the range of the selected keyword into a numerical value. If the selected keyword corresponds to the 10th to 15th characters from the beginning of the text, the range is converted into a numerical value of (10, 15). From this numerical value, the location **202** shown in FIG. **2** is obtained. The range of a selected keyword can be represented by any method if even the location of the selected keyword can be specified.

In step S**304**, the keyword score calculation unit **112** calculates a score from the type of marker and a user's method of selecting a keyword using the marker. The score is indicated by a fractional value of “0.0” to “1.0”, for example. The larger the fractional value, the more important the selected keyword. A portion that is not marked with a marker, or a character string in text, which is not a selected keyword, is considered to be less important and its score is set to “0.0”.

In the keyword selecting method using a marker, for example, a score can be increased by marking the same keyword with a marker two times. More specifically, with reference to FIG. **2**, when a user selects a keyword “Kingdom of the Two Sicilies” with a yellow marker and an underline, the score “0.5” of the yellow marker and the score “0.3” of the underline can be added together to obtain score “0.8”. The score can be indicated by any numerical value if it can represent the importance of a keyword.

In step S**305**, the keyword score calculation unit **112** stores the selected keyword, the range of the selected keyword, the type of marker and the score in the markup database **105**. After that, the operation of the markup management unit **104** is completed.

The operation of the tagged text generation unit **106** will be described below with reference to the flowchart of FIG. **4**.

In step S**401**, the synthesis parameter generation unit **113** acquires text.

In step S**402**, the synthesis parameter generation unit **113** extracts markup information from the markup database **105**.

In step S**403**, the synthesis parameter generation unit **113** generates an SSML tag and a synthesis parameter for each keyword. The generated synthesis parameter is, e.g., a parameter for adjusting the pitch, volume, rate and voice of synthesized speech.

In step S404, the synthesis parameter generation unit **113** adjusts the synthesis parameter in accordance with the scores. For example, linear interpolation has only to be performed between scores "1.0" and "0.0", as will be described later.

In step S405, the tag addition unit **114** adds an SSML tag corresponding to the synthesis parameter to a keyword to generate text with the SSML tag. After that, the operation of the tagged text generation unit **106** is completed.

An example of a method for generating a synthesis parameter by the synthesis parameter generation unit **113** will be described below with reference to FIG. **5**.

The synthesis parameter generation unit **113** may have a table as shown in FIG. **5**. FIG. **5** shows the value of a synthesis parameter when the score **205** shown in FIG. **2** is "1.0."

In the table of FIG. **5**, a marker type **501**, reading **502** and a synthesis parameter **503** correspond to one another. For example, the marker type **501** is "yellow marker," the reading **502** is "<prosody pitch>" and the synthesis parameter **503** is "30%" and these correspond to one another. In the example of FIG. **5**, therefore, when a keyword is marked with a yellow marker, the pitch of synthesized speech is increased 30% and when a keyword is marked with a red marker, the "<volume>" of synthesized speech is set at "+100" and the "<rate>" thereof becomes "−50%." If a keyword is underlined, the "<emphasis>" of synthesized speech is set at "strong." If a keyword is marked with a wavy line, the "<voice>" of synthesized speech is set to "Alice."

It depends on user's indication what SSML tag and what synthesis parameter can be assigned to each of the markers by the parameter assignment unit **107**. A portion in text to which no SSML tag is added is spoken in default speech.

An example of a method for adjusting the score of a keyword by the synthesis parameter generation unit **113** will be described below with reference to FIG. **6**.

FIG. **6** shows a graph **601** of linear interpolation of the synthesis parameter, in which the vertical axis indicates the volume of synthesized speech and the horizontal axis indicates the score of a keyword. As shown in FIG. **6**, when the score is "1.0," the values set by the synthesis parameter shown in FIG. **5** are used. The synthesis parameter is adjusted in such a manner that the volume of synthesized speech linearly decreases as the score becomes close to "0.0" and default speech is made when the score is "0.0." Adjusting the synthesis parameter in accordance with the score, when a selected keyword is more important and its score is higher, a difference between the default speech and the synthesized speech becomes wider, which attracts user attention. When a selected keyword is less important and its score is lower to the contrary, a difference between the default speech and the synthesized speech becomes smaller, which does not attract user attention.

A qualitative SSML tag such as emphasis and voice cannot change a parameter even by linear interpolation as shown in FIG. **6**. Using a known technique called speech morphing, the synthesized speech can be made close to the default speech gradually in accordance with the score of a keyword.

Not only the linear interpolation but also any interpolation method can be employed if the synthesized speech can be made close to the default speech as the score of a keyword becomes lower. The score of a keyword can be set high at the beginning of learning and then it can be set low as user's memorization advances.

An example of use of a speech learning apparatus according to the first embodiment will be described with reference to FIG. **7**.

FIG. **7** shows an example of text displayed on the display **108** in which a user looks at the text of the world history on the assumption that he or she browses an electronic book or an electronic textbook. The title of content and content ID **702** are added to text **701**.

The user is able to draw an underline **704** and a color marker **705** on the displayed text **701** with a finger or a stylus **703**, as in the case where a user draws an underline and a marker on a paper book. The display **108** includes a pallet **706** in which usable markers are displayed and the pallet **706** includes markers such as an underline **704** and color markers **705** and an erase marker (eraser) **707** for erasing the markers. The user is able to select one of the markers by touching its corresponding button in the pallet **706** with his or her finger or the stylus **703**.

If the user draws an underline on the portion of "19th century Italy" as a keyword to be memorized, the voice of the underlined portion can be changed to synthesized speech. If the user draws a red marker on the portion of "Cavour," its synthesized speech can be emphasized.

To emphasize a keyword, it can be circled, surrounded with a rectangle, and written in bold and italics, and its font can be changed. In other words, a keyword in text may be emphasized by any means if the means can specify the range of the keyword in the text and produce a visual effect in the text.

The user is able to play the synthesized speech by touching a synthesized speech play button **708**. The user is also able to save the synthesized speech as a file and listen to it through another device. For example, the user is able to save the synthesized speech by touching a synthesized speech save button **709** and listen to it through an audio player.

An example of tagged text generated by the tag addition unit **114** will be described with reference to FIG. **8**.

As shown in FIG. **8**, an SSML tag **801** is added to a keyword **802**. For example, in order to emphasize a keyword "19th century Italy," it is interposed between SSML tags "<emphasis level="strong">" and "</emphasis>." Likewise, a keyword "Pope's territory" is interposed between SSML tags "<prosody pitch="+30%">" and "</prosody>" to adjust the pitch of the keyword. In accordance with these SSML tags, the speech synthesis unit **109** performs speech synthesis to generate synthesized speech and output it from the speech output unit **110**.

The thickness of a marker and a line can be varied with the score of a keyword. If the display of a marker as well as the synthesized speech is varied with the score of a keyword, a user can more easily understand what the user should pay attention to in his or her learning.

According to the first embodiment described above, a keyword designated by a user can be emphasized visually and audibly by generating a synthesis parameter in accordance with the type of marker. In other words, if a user has only to mark an important keyword by interacting with a apparatus, the emphasis of synthesized speech of the keyword can be varied. As a result, the synthesized speech of the keyword differs from other words and thus the user who listens to the synthesized speech is able to pay attention to the keyword and support efficient learning.

Second Embodiment

In the first embodiment, the synthesis parameter is varied with the score of a keyword which depends upon the type of marker designated by a user and the method for designating the keyword with the marker. In the second embodiment, a score of a keyword designated by a user is determined on the basis of markup information shared with another user. Accordingly, the user is able to support his or her efficient learning in accordance with his or her leaning stage.

A speech learning apparatus according to the second embodiment will be described with reference to FIG. **9**.

FIG. **9** shows a speech learning apparatus **900** according to the second embodiment. The apparatus **900** includes an input means selection unit **101**, an acquisition unit **102**, a text acquisition unit **103**, a tagged text generation unit **106**, a parameter assignment unit **107**, a display **108**, a speech synthesis unit **109**, a speech output unit **110**, a local markup management unit **901**, a local markup database **902**, a social keyword score calculation unit **905**, a markup management server **903**, a social markup database **904** and an integration unit **906**.

The descriptions of the input means selection unit **101**, acquisition unit **102**, text acquisition unit **103**, tagged text generation unit **106**, parameter assignment unit **107**, display **108**, speech synthesis unit **109** and speech output unit **110** are omitted here because these units perform the same operations as those in the first embodiment.

The local markup management unit **901** performs almost the same operation as that of the markup management unit **104** of the first embodiment and differs in that it transmits markup information stored in the local markup database **902** (referred to as local markup information hereinafter) to the markup management server **903**.

The description of the local markup database **902** is omitted here because it performs the same operation as those of the markup management unit **104** and the markup database **105** of the first embodiment.

The markup management server **903** receives markup information from the local markup management unit **901** and sends it to the social markup database **904**. The markup management server **903** also extracts markup information of another user from the social markup database **904**.

The social markup database **904** receives markup information from the markup management server **903** and stores it. The social markup database **904** also stores social markup information that is markup information of another user.

The social keyword score calculation unit **905** receives markup information of another user from the markup management server **903** and calculates a score of each keyword from the markup information of another user. Hereinafter, the score obtained from the markup information of another user is called a social score.

The integration unit **906** receives a score based on the local markup information (which is also called a local score) from the local markup management unit **901** and also receives a social score from the social keyword score calculation unit **905**. Then, the integration unit **906** calculates an integration score that is a weighted value of the local score and the social score.

An operation of the speech learning apparatus **900** according to the second embodiment will be described with reference to the flowchart shown in FIG. **10**.

In step S**1001**, the local markup management unit **901** transmits markup information to the markup management server **903**.

In step S**1002**, the social keyword score calculation unit **905** receives markup information of another user, which is stored in the social markup database **904**, from the markup management server **903**.

In step S**1003**, the social keyword score calculation unit **905** calculates a social score of each keyword from the social markup information. The social score of a keyword has only to be obtained by a statistical value such as an average of scores when the keyword is marked up by a plurality of users.

In step S**1004**, the integration unit **906** calculates an integration score of each keyword from the local score and the social score. If the weight of the local score is 0.0 and that of the social score is 1.0, only the social score is reflected in synthesis speech and text displayed on the display unit. If the weight of the local score is 0.5 and that of the social score is 0.5, an average score is obtained. After that, the operation of the speech learning apparatus according to the second embodiment is completed.

The social markup information stored in the social markup database **904** will be described with reference to FIG. **11**.

The social markup information **1101** shown in FIG. **11** is almost the same as the markup information shown in FIG. **3** and differs in that a user ID **1102** for identifying a user is added thereto. For example, three users with IDs of “100,” “200” and “300” add a marker to the keyword “Kingdom of Sardinia.” Referring to the user ID **1102**, the social keyword score calculation unit **905** identifies a user and calculates a social score. For example, if the “Kingdom of Sardinia” is a keyword, the social score can be obtained as “(0.8+1.0+0.8)/3=0.86” from the social markup information of the three users.

With the markup management server **903**, level information indicative of the progress of each user’s learning may be stored in the social markup database **904** in association with the social markup information. When a plurality of users execute learning programs using the same text, keywords in the text should vary in their importance between beginning and advanced learners. For example, advanced learners need to memorize more particular keywords than beginning learners, and a keyword that is important to beginning learners may not be so important to advanced learners because they have already memorized it.

If, therefore, level information of each user is stored in the social markup database **904**, it is possible to extract only the markup information of users of the same level and calculate a statistical value of scores.

According to the second embodiment described above, if a user who is a beginning learner refers to the markup information of another user, the beginning learner is able to know a keyword that a number of users recognize as important even though he or she does not know whether the keyword is important, with the result that efficient learning can be supported.

Third Embodiment

The third embodiment differs from the above embodiments in that the score of a keyword varies with the status of learning.

The speech learning apparatus **1200** according to the third embodiment will be described with reference to the block diagram shown in FIG. **12**.

The apparatus **1200** includes an input means selection unit **101**, an acquisition unit **102**, a text acquisition unit **103**, a markup management unit **104**, a markup database **105**, a tagged text generation unit **106**, a parameter assignment unit **107**, a display **108**, a speech synthesis unit **109**, a speech output unit **110**, a learning history management unit **1201**, a question making unit **1202**, a keyword type estimation unit **1203** and a learning history database **1204**.

The learning history management unit **1201** receives a marked-up keyword from the markup management unit **104**. The unit **1201** also receives user's answers from the question making unit **1202**, which will be described later and calculates a correct answer rate based on the user's answers to make a learning history. The learning history includes information of a question-making date, the number of questions, the number of correct answers, a correct answer rate and the like.

The question making unit **1202** receives a type of keyword from the keyword type estimation unit **1203** and converts a character string of a keyword in text into that of the type of keyword. The type of keyword indicates an attribute of the keyword. As the type of keyword, there are the names of nations, persons and eras, for example. After that, the question making unit **1202** makes a question about a character string of the type of keyword to a user and receives a user's answer to the question.

The keyword type estimation unit **1203** receives a keyword from the learning history management unit **1201** to estimate a type of the keyword. The type of keyword has only to be estimated using a commonly known technique that is called named entity extraction.

The learning history database **1204** receives a learning history of questions about a keyword from the learning history management unit **1201** and stores it.

An operation of the speech learning apparatus **1200** according to the third embodiment will be described with reference to the flowchart of FIG. **13**.

In step S**1301**, the keyword type estimation unit **1203** estimates a type of keyword.

In step S**1302**, the question making unit **1202** converts a character string of a keyword in text into that of the type of keyword. If the keyword is "Italy," the type of keyword is "name of nation" and thus the character string of the keyword in text is converted from "Italy" to "name of nation."

In step S**1303**, the question making unit **1202** makes a question about a character string of the type of keyword to a user.

In step S**1304**, the acquisition unit **102** acquires an answer from the user. For example, the unit **102** has only to acquire it through a stylus or a keyboard. When the display **108** displays no text and the user uses his or her speech only, the speech can be recognized by a speech recognition unit (not shown).

In step S**1305**, the question making unit **1202** compares the keyword as a question and the user's answer and determines whether or not the answer is correct, thereby obtaining a result of the answer. After that, the learning history management unit **1201** calculates a correct answer rate based on the result of the answer.

In step S**1306**, the learning history management unit **1201** makes a learning history including the correct answer rate and stores it in the learning history database **1204**.

In step S**1307**, the keyword score calculation unit **112** refers to the learning history database **1204** and reflects the correct answer rate in the score of the keyword. For example, it is considered that a keyword with a high correct answer rate has already been memorized by a user and thus the importance of the keyword is lower than that of a keyword that has not been memorized yet. Conversely, it is considered that a keyword with a low correct answer rate has not yet been memorized by a user and thus its importance is high. Accordingly, the keyword score calculation unit **112** calculates a score of the keyword from the correct answer rate in such a manner that the score becomes lower as the correct answer rate increases and the score becomes higher as the correct answer rate decreases. As a simple method, a score can be calculated by subtracting the correct answer rate from 1.0. Any other method can be employed if the correct answer rate and the score are inversely proportional to each other. After that, the operation of the speech learning apparatus according to the third embodiment is completed.

If the keyword score calculation unit **112** calculates a keyword score and the tagged text generation unit **106** generates a synthesis parameter, it is possible to output synthesized speech of the emphasized keyword in accordance with user's learning state.

An example of use of the speech learning apparatus **1200** according to the third embodiment will be described with reference to FIG. **14**.

FIG. **14** shows an example of a question displayed on the display **108** by the question making unit **1202**. Assume here that "person's name" of the keyword **1401** is displayed as a question and a user answers "Cavour" in an answer column **1402**. A learning history display area **1403** displays a learning history, such as "eight correct answers/ten questions" and "correct answer rate of 80%."

As an example of use, the following operation can be considered. The score of a keyword is set high at the beginning of user's learning, and the keyword is easily memorized by emphasizing its synthesized speech. As the memorization increases, the synthesized speech is returned to a default speech by lowering the score gradually from a memorized keyword with a high correct answer rate. Accordingly, the synthesized speech of a keyword is well-modulated and a user can clearly know what should be noted to memorize the keyword.

When a question is made by speech, the character string of the type of a keyword into which the keyword is converted has only to be read. If a keyword is converted into "person's name" as a type, the speech synthesis unit **109** has only to synthesize the speech of the "person's name."

According to the third embodiment described above, a question about a keyword is given to a user and the correct answer rate of the question is reflected in the score of the keyword, with the result that a user increases in motivation for learning in the form of a quiz and efficient learning can be supported.

In the above embodiments, a high-score keyword is emphasized using an SSML tag; however, it can be emphasized without using an SSML tag. For example, a keyword can be emphasized by any other means of speaking a high-score keyword repeatedly, pausing before and after a keyword, producing sound effects and making an auxiliary speech such as "this is important." The flow charts of the embodiments illustrate methods and systems according to the embodiments. It will be understood that each block of the flowchart illustrations, and combinations of blocks in the flowchart illustrations, can be implemented by computer program instructions. These computer program instructions may be loaded onto a computer or other programmable apparatus to produce a machine, such that the instructions which execute on the computer or other programmable apparatus create means for implementing the functions specified in the flowchart block or blocks. These computer program instructions may also be stored in a computer-readable memory that can direct a computer or other programmable apparatus to function in a particular manner, such that the instruction stored in the computer-readable memory produce an article of manufacture including instruction means which implement the function specified in the flowchart block or blocks. The computer program instructions may also be loaded onto a computer or other programmable apparatus to cause a series of operational steps to be performed on the computer or other programmable apparatus to produce a computer programmable apparatus which provides steps for implementing the functions specified in the flowchart block or blocks.

While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the inventions. Indeed, the novel embodiments described herein may be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the embodiments described herein may be made without departing from the spirit of the inventions. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the inventions.

What is claimed is:

1. A speech learning apparatus comprising:

a processor, programmed to

detect a keyword corresponding to a character string selected from a text;

calculate a score indicating a degree of emphasis of the keyword based on a manner of selecting the keyword;

generate a synthesis parameter to determine a degree of reading of the keyword in accordance with the score;

add to the keyword a tag for reading the keyword in accordance with the synthesis parameter;

generate synthesized speech obtained by synthesizing speech of the keyword in accordance with the tag;

calculate a social score indicating a score of the keyword selected by one or more other users different from the user; and

calculate an integration score using the score and the social score,

wherein the synthesis parameter is generated in accordance with the integration score.

2. The apparatus according to claim **1**, wherein the synthesis parameter is generated such that as the score decreases, the reading becomes closer to that in a case where the tag is not added.

3. The apparatus according to claim **1**, further comprising a marker that is used for the manner of selecting the keyword, the reading varies with a type of the marker.

4. The apparatus according to claim **1**, wherein the processor is further programmed to

give a question relating to a keyword to the user; and

calculate a correct answer rate based on an answer to the question from the user, to generate a learning history including information associated with the question and the correct answer rate,

wherein the score indicating the degree of emphasis of the keyword calculates the score which becomes lower as the correct answer rate increases, in accordance with the learning history.

5. The apparatus according to claim **4**, wherein the processor is further programmed to

estimate an attribute of the keyword,

wherein the giving of the question relating to the keyword to the user converts a first character string indicating the keyword into a second character string indicating the attribute, and

wherein the generated synthesized speech obtained by synthesizing speech of the keyword synthesizes speech of the second character string.

6. A speech learning method comprising:

detecting a keyword corresponding to a character string selected from text from a text acquisition unit comprising a stylus or a keyboard;

calculating a score indicating a degree of emphasis of the keyword based on a manner of selecting the keyword;

generating a synthesis parameter to determine a degree of reading of the keyword in accordance with the score;

adding to the keyword a tag for reading the keyword in accordance with the synthesis parameter;

generating synthesized speech obtained by synthesizing speech of the keyword in accordance with the tag;

calculating a social score indicating a score of the keyword selected by one or more other users different from the user; and

calculating an integration score using the score and the social score,

wherein the generating the synthesis parameter generates the synthesis parameter in accordance with the integration score.

7. A non-transitory computer readable medium including computer executable instructions, wherein the instructions, when executed by a processor, cause the processor to perform a method comprising:

detecting a keyword corresponding to a character string selected from text;

calculating a score indicating a degree of emphasis of the keyword based on a manner of selecting the keyword;

generating a synthesis parameter to determine a degree of reading of the keyword in accordance with the score;

adding to the keyword a tag for reading the keyword in accordance with the synthesis parameter;

generating synthesized speech obtained by synthesizing speech of the keyword in accordance with the tag;

calculating a social score indicating a score of the keyword selected by one or more other users different from the user; and

calculating an integration score using the score and the social score,

wherein the generating the synthesis parameter generates the synthesis parameter in accordance with the integration score.

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